You Acidify The Water, They Pay The Price: The Effect Of Ocean Acidification On Crabs

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Introduction

When it comes to issues involving carbon dioxide, most people think of global warming. Many are not aware that there is another critical issue facing our world's oceans. Ocean acidification is the decrease in ocean pH due to higher levels of dissolved carbon dioxide, and is a phenomenon currently endangering the Earth's oceans. Research suggests that water with lower pH levels can negatively affect the carapaces of crabs. We became interested in this topic because we wanted to find out if crabs' behavior can be affected by exposure to water with low pH levels. It is important that humans are aware of ocean acidification's potential negative effects on marine organisms. Humans will ultimately be affected, because every living thing is connected through a food web.

Materials and Methods

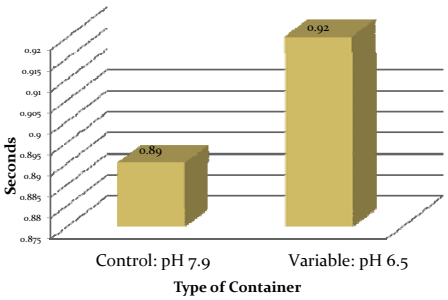
•The crab traps set at Elkhorn Slough baited with anchovies were picked up the next morning and contents were separated by species: European Green Crabs, *Carcinus Maenas*, and Green Shore Crab, *Hemigrapsus Oregonensis*.
•Two treatment containers were set up with the same amount of water from the site. Our group measured pH, temperature, and dissolved oxygen of both containers. One container was the control and the other the variable.
•Concentrated CO_2 was added into the variable container and two minutes later pH was measured and crabs were placed into their assigned containers.
•Crabs were left in their containers for five minutes before the beginning of first trial. Crabs were pinned onto their backs for three seconds and timed from the second we let go until they were standing.
•Repeat step four, two more times for each crab. Our group recorded data which showed that the low pH didn't have a rapid negative effect on their righting behavior, as the crab in the variable container flipped back a little quicker at times.
•The last step of the project was to Collect 12 crabs; 6 of 2 different species, and take them back to the lab. In the lab we followed the same protocol however we had two separate containers which contained crabs that were exposed to concentrated CO_2; one for a week and the other for three weeks.
• After proceeding with the Flipping Test, we numbed the crab with ice and we broke the claws and took blood samples from the joints.
• Once we took blood samples we measured its pH level. This protocol was used six days out in the field and one in the lab.

•Dissolved oxygen meter
•pH meter
•Thermometer
•Dissolved Carbon dioxide
•Plastic tubs/Containers
•Stop watches (2)
•Nokia cameras (2)
•Chest waders (Minimum 2)
•Washing gloves (Minimum 3 pairs)
•Towel
•Measuring cup
•Measuring tape
•Water boots (4 pairs)
•Crab traps

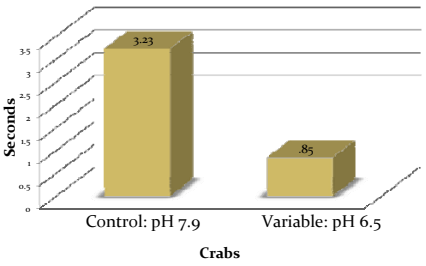
Results

The initial results of the crabs in both the control (6.5pH) and variable (7.9pH) containers were nearly identical. This means that a lower pH level does not have a rapid effect on crab's behavior. The crabs in the low pH container on average took .89 seconds to flip back, while the crabs in the variable container took .92 seconds. The results differentiated after one week in the lab as the crabs in the low pH water took 3.23 seconds on average and the crabs in the variable container took .85 seconds to flip back. The results of the crabs in the lab for 3 weeks were similar to those we had at the site. The crabs in the control group took 1.00 second on average while the crab in the variable group took 1.52 seconds to flip back. The blood pH level in the control crabs drop in both week 1 and week 3. However the blood pH of the 3 week crabs after exposure began to neutralize. In week 1 it was 7.14 while in week 3 it went to 7.49. The average blood pH level for crabs is 7.7 to 8.0.

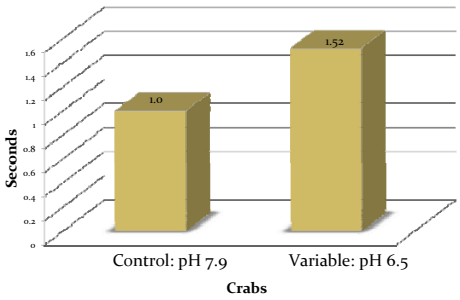
Average of Initial Rate of Flipping



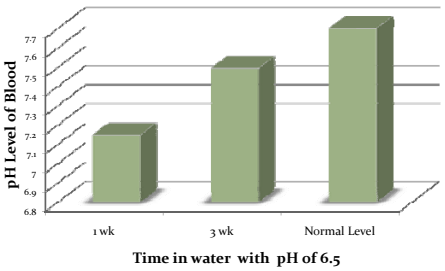
Average Rate of Flipping: 1 Week in Lab



Average Rate of Flipping: 3 Weeks in Lab



Blood pH of Crabs



Conclusion

Our data allows us to infer that there was an acute affect from the collection day to week one. The blood pH of the crabs in week one dropped noticeably in comparison to the normal pH of blood. The side effects of this were shown when the behavior of the crabs had a dramatic change; in the graph you can see that the crabs were flipping back faster after a week of exposure to a 6.5 pH level. However, one can argue there was a chronic affect as the blood pH results of week 3 began to go up as the crabs made a physiological adjustment. There was a relation between these results and the behavior change, as the crabs began to flip back slower.
Our results showed that the crabs' behavior was slowed down because of their prolonged exposure to lower than normal pH levels in water. With this information we can infer that ocean acidification may have a negative impact on crabs' behavior. If the reaction rate of crabs is slowed down, this increases their vulnerability to be preyed on by other animals. It will also be more difficult for them to find food and capture prey because they will react slower, allowing their prey to evade them faster. If crabs are not able to capture their prey efficiently, they will eventually start to decrease in population, impacting other species in their ecosystem.
The reason why our oceans are becoming more acidic is because humans continue to burn large amounts of fossil fuels at a very fast pace, ultimately resulting in negative impacts on animals like crabs. Our group is taking action by educating our local community about ocean acidification and its harmful effects but more importantly, things they can do individually to help minimize the burning of fossil fuels. One way we will be reaching out to our community is by presenting a video that our group produced that shows how animals can be affected by ocean acidification and some basic changes we can make in our daily lives to reduce our carbon footprint.

Literature Cited

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